

Claims

1. Method for improving the depth discrimination of optical systems comprising a) illumination of an object with a periodic structure, b) registration of the resulting brightness distribution, c) displacement of the phase position of the periodic structure, d) repetition of steps a) to c) until at least three brightness distributions have been registered, e) calculation of the registered brightness distributions to obtain an object brightness distribution, characterized in that f) the displacements of the phase positions from c) are registered, g) brightness variations of the illumination are detected, h) bleaching phenomena of the object in fluorescence illumination are determined, and calculation is carried out taking into account the results obtained in steps f) to h).

2. Method for improving the depth discrimination of optical systems according to claim 1, characterized in that the bleaching phenomena of the object in fluorescence illumination are determined in that regions of identical illumination intensity are determined from preferably successively registered brightness distributions and these regions are compared to one another with respect to brightness.

3. Method for improving the depth discrimination of optical systems according to claim 2, characterized in that a scaling factor is carried out by taking the quotients of the registered brightnesses of the regions of identical illumination intensity and the registered brightness distributions are scaled using this scaling factor.

4. Method for improving the depth discrimination of optical systems according to claim 1, characterized in that the determination of the object brightness distribution $m(x, y)$ is carried out by means of the equation

$$m(x, y) = \frac{\sqrt{a_1^2(x, y) + a_2^2(x, y)}}{a_0(x, y)},$$

wherein the vector

$$\vec{a} = \begin{pmatrix} a_0(x, y) \\ a_1(x, y) \\ a_2(x, y) \end{pmatrix}$$

is determined by solving a system of equations from the linking of the registered brightness distributions $I_i(x, y, \phi_i)$ to the registered phase displacements ϕ_i , where i represents the quantity of registrations of the brightness distribution.

5. Method for improving the depth discrimination of optical systems according to claims 3 and 4, characterized in that the equation system links the scaled brightness distributions to the registered phase displacements.

6. Method for improving the depth discrimination of optical systems according to claim 1, characterized in that a calibration of the displacements of the phase position is carried out, wherein a) an object, which is preferably a mirror surface, is illuminated by a periodic structure, b) a first brightness distribution is registered, c) the phase position of the periodic structure is changed by a small, definite amount which is registered, d) a second brightness distribution is registered, e) the difference between the two brightness distributions is determined and assessed with respect to stripe distribution, f) steps c) to e) are repeated until the valuing of the difference between the first brightness distribution and the subsequent brightness distribution results in an extremum; and g) the value of the phase position of the periodic structure found in this way is registered.

7. Method for improving the depth discrimination of optical systems according to claim 1, characterized in that errors resulting from non-sinusoidal distribution of the illumination of the object are corrected.

8. Method for improving the depth discrimination of optical systems according to claim 7, characterized in that higher harmonics of the fundamental frequency of the periodic structure are filtered out of the brightness distribution by means of bandpass filters.

9. Method for improving the depth discrimination of optical systems according to claim 1, characterized in that the registered brightness distributions are calculated by taking into account correction values, preferably for taking into account variations in

brightness of the illumination, bleaching of the object in fluorescence illumination, and non-sinusoidal distribution of the illumination of the object, which are determined by linear optimization.

10. Method for improving the depth discrimination of optical systems according to claim 9, characterized in that the linear optimization is applied to a merit function of the following form:

$$M(\theta_i; d; b) = \alpha_0 \left| F\{\bar{a}\}_0 \right|^2 + \alpha_1 \left| F\{\bar{a}\}_\omega \right|^2 + \alpha_2 \left| F\{\bar{a}\}_{2\omega} \right|^2 + \dots + \alpha_n \left| F\{\bar{a}\}_{n\omega} \right|^2 \rightarrow \min ,$$

where $F\{a\}$ is a functional transform of vector a , θ_i are scalar factors for characterizing the variation in brightness of the illumination, d is a measurement for the bleaching of the object in fluorescence illumination, b is a factor for characterizing the non-sinusoidal distribution of the illumination of the object, and α_i are weighting coefficients for adapting to the recording conditions, preferably with respect to different signal-to-noise distances or preferred frequencies.

11. Method for improving the depth discrimination of optical systems according to claim 1, characterized in that bleaching phenomena of the object in fluorescence illumination are determined by determining a local correction function from preferably successive brightness registrations.

12. Method for improving the depth discrimination of optical systems according to claim 11, characterized in that this correction function is determined by averaging over at least one period of the periodic illumination structure.

13. Method for improving the depth discrimination of optical systems according to claim 11, characterized in that spiking of the calculated local correction function occurring in the neighborhood of edges of the bleaching function which are contained in the object is prevented by substituting an estimated value.